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Can Listening to Music while Exercising Lower the Rate of Perceived Exertion During Exercise?

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Abstract

OBJECTIVE: To determine whether or not "listening to music during exercise can help decrease the rate of perceived exertion?"

STUDY DESIGN: A Review of two randomized controlled trials studies and a controlled trial study from 2000-2009 that were in the English language.

DATA SOURCES: Randomized controlled trials and controlled trials comparing the effect of music on RPE were found using PubMed, MEDLINE, and COCHRANE Databases.

OUTCOMES MEASURED: The outcomes measured in the studies were: rate of perceived exertion, enjoyment, and endurance time. Rate of perceived exertion is measured on the Borg Scale, either on a 15-point (6-20) or an 11-point (0-10) scale. It is a subjective scale where the patients are given the criteria and report how hard they feel they are working. Enjoyment is measured on the Intrinsic Motivational Inventory Scale, a multidimensional measurement tool that is used to assess participants' subjective experience related to a specific activity in an experiment. Endurance time is measured based on the amount of time the participant is able to workout until they reach exhaustion.

RESULTS: The results from the Potteiger et al. (2000) found that music has the possibility to passively distract participants and influence RPE during moderately intense exercise. The Dyrlund and Wininger (2008) study results were inconclusive. They found that music has the potential for enhancing enjoyment during exercise if the music is prominent enough to gain the participants' attention. The effects of listening to music on RPE showed no significant difference. The Karageorghis et al. (2009) study refuted the hypothesis that RPE would be lower for the participants in the motivational music category compared to the oudeterous music group and no music control group.

CONCLUSIONS: The results of whether or not listening to music during exercise can decrease RPE are inconclusive at this time, due to the lack of definitive results the hypothesis is rejected. For clarification on this more research should be done to account for the uncontrolled variables and new questions that arose from these current studies.

KEY WORDS: Music, Rate of Perceived Exertion (RPE), Exercise

INTRODUCTION

Obesity is very prevalent in the United States, which may be treated with exercise. It has been proposed that listening to music can help lower the rate of perceived exertion while exercising, which can help fight the ever growing epidemic of obesity by promoting exercise adherence. Today more than 60% in the United States is either overweight or obese.[1] This puts more than half of the US population at a Body Mass Index (BMI) of greater than or equal to 25.[1] This is directly relevant to the field of practice of a Physician Assistant because 2 out of 3 adult patients seen will be overweight or obese, in every field of practice. As a PA it will be pertinent to be able to offer up a variety of treatment options to help fight the current weight problems faced by many patients, exercise is one of those options. Being obese or overweight has a detrimental effect on patients' overall health. Obesity is a risk factor for a number of chronic conditions such as hypertension, coronary artery disease, hyperlipidemia, stroke, heart disease, cancer, arthritis, gall bladder and liver disease, sleep apnea, and especially diabetes.[1, 2, 3] There is an extra financial burden placed on patients due to being overweight or obese. The annual costs of being overweight are: $524 for women, $432 for men.[1] The annual costs of obesity are: $4,879 for a woman, $2,646 for a man.[1] Further more, according to the CDC, this can be broken down to extra direct medical costs, for overweight patients they spend $346 more and obese patients spend $1,474 more on medical expenses yearly.[1, 4] When it comes to the treatment of obesity and being overweight individualized programs that are structured have been found to be effective. These plans include lifestyle changes, dietary changes with fat intake reductions, regular exercise and physical activity plans, and education with regular contact with regular follow-ups.[2, 3] But when it comes to preventing, and even treating, overweight and obesity issues on a more widespread level there are very little known.[3] There is not a unified

plan in place that can be applied to all patients since each patient is different in treatment approaches and what will work for them. The main treatments that are sought out for overweight and obesity are: dieting, exercise, and gastric bypass surgery. But after undergoing gastric bypass patients will have to be on a strict diet and follow and exercise program.

This paper evaluates 2 randomized control trials and a controlled trial on the effects of music on the rate of perceived exertion during a bout of exercise. Being that exercise is one of the main areas of treatment for overweight and obesity there have been studies done to look at ways to lower the rate of perceived exertion of participants during bouts of exercise. The theory behind this is that if the patient perceives that they are not working as hard then they can maintain a higher intensity for a longer time or exercise for a longer duration than normal.[5] If patients feel like they are not working as hard there might be increased exercise adherence, as well as positive treatment outcomes.[5] Listening to music while exercising is one of the ways being studied to see if it will lower the rate or perceived exertion. Rate of Perceived Exertion (RPE) is defined as how hard you feel you are working and can be interpreted as a good measure of heart rate. Some of the subjective ratings of RPE are based on: heart rate, respiration rate, physical fatigue, and mental fatigue. Music is one of the interventions used, the music can be motivational or oudeterous. The definition of motivational music is that it gives incentive to keep going, the main characteristics is a fast paced tempo with a strong rhythm.[6] While oudeterous music is defined as music that is neutral and isn't motivation or de-motivational.[6]

OBJECTIVE

The objective of this systematic review is to determine whether or not "listening to music during exercise can help decrease the rate of perceived exertion?"

METHODS

The studies used in this paper were found after a detailed search by the author, using the search engines PubMed, MEDLINE, Cochrane Database of Randomized Controlled Trials, and the Cochrane Database of Systematic Reviews. The keywords used in the search were "music", "exercise", and "rate of perceived exertion". All of the articles were in English and published in peer-reviewed journals between 2000 to 2009. They were also selected based on the importance that the outcomes had to patients, which is otherwise known as Patient Oriented Evidence that Matters (POEMS). The types of studies included were randomized controlled trials and a controlled trial. The types of studies excluded were meta analysis or systematic reviews. Table 1 includes the demographics of the three included studies. The statistics reported included: P-values where a value of <0.05 is clinically significant.

In the Karageorghis et al. (2009) randomized control study there were 30 volunteers from the sport science undergraduate program at Brunel University, 15 males and 15 females. All participants were Caucasian and raised in the United Kingdom. They also were picked from running based sports, like soccer, rugby, and field hockey, for some form of unity in fitness level. Participants were only out-field players were used and goalies were excluded. The interventions and comparison groups that were addressed were: motivational music versus oudeterous music versus no music. The outcomes that were studied were: Rate of Perceived Exertion measured on the Borg Scale. The outcomes were measured with a repeated Two-Way 3x3 ANOVA.

In Dyrlund and Wininger (2008) the study was a controlled trial with 200 volunteers from a psychology class, extra credit was given to participants. There were 126 females between the ages of 18 to 54 that were not pregnant, and 74 males that were between the ages of 18 to 44.

Participants were screened using the PAR-Q and ASCM Risk Stratification. The participants were broken down into nine subgroups for the interventions: low intensity with no music, moderate intensity with no music, high intensity with no music, low intensity with least preferred music, moderate intensity with least preferred music, high intensity with least preferred music, low intensity with most preferred music, moderate intensity with most preferred music, and high intensity with most preferred music. The outcomes that were measured were: enjoyment, RPE, attentional focus, and attend to focus. The outcomes were measured with: the Borg Scale for RPE, the Intrinsic Motivation Inventory, One-Way ANOVA, 3x3 ANOVA, and a 3x3 repeated ANOVA.

In the Potteiger et al. (2000) randomized control study there were 27 physically active volunteers, 14 males and 13 females. Each participant was screened for any contraindication by a health questionnaire form. Exclusion criteria were not included. The interventions used were: fast music, classical music, self-selected music, and no music. The outcome studied was: rate of perceived exertion. The outcome was measured with: the Borg Scale, a Three-Way Repeated Measures Analysis of Variance, Tukey's HSD *post hoc* test.

Table 1. The demographics of the included studies.

"Can listening to music lower your rate of perceived exertion during exercise?"

Study	*Type of Study*	*# Pts*	*Age(yrs)*	*Inclusion Criteria*	*Exclusion Criteria*	*W/D*	*Interventions*
Dyrlund, USA, 2008	Controlled Trial	200	20.69 (SD 4.41)	Students from a Psychology class	Not included	Not Included in the results section	Music Intervention (no music, least preferred, most preferred) Exercise Intensity (low, moderate,

							high)
Karageorghis, UK, 2009	RCT	30	20.9 (SD 1.1)	Sport Science Undergraduate Student Volunteers, Caucasian, Raised in the UK, Running Based Sports	No in-field players such as (goalies)	0, but 2 subjects data were not included in the results due to non-compliance issues, and then 2 more results were not included after being determined to be outliers	Motivational music vs. Oudeterous music
Potteiger, USA, 2000	RCT	27	18-30	Physically Active	Not Included		Music Intervention vs. No Music

OUTCOMES MEASURED:

The outcomes that were measured in the studies included: rate of perceived exertion, enjoyment, and endurance time. Rate of perceived exertion is measured on the Borg Scale, which can be either be a 15-point (6-20) or an 11-point (0-10) scale. It is a subjective scale where the patients are given the criteria and report how hard they feel they are working. Enjoyment is measured on the Intrinsic Motivational Inventory Scale, a multidimensional measurement tool that is used to assess participants' subjective experience related to a specific activity in an experiment. Endurance time is measured based on the amount of time the participant is able to workout until they reach exhaustion.

RESULTS

In the Karageorghis et al. (2009) randomized control study the outcomes that were studied were: Rate of Perceived Exertion measured on the 11-point Borg Scale and endurance time. The outcomes were measured with a Two-Way repeated 3x3 ANOVA and a One-Way repeated measures ANOVA. RPE was calculated at two minutes after the start, at the midpoint, and two minutes before voluntary exhaustion. When the results were examined it was determined that 2 participants, one male and one female, were noncompliant therefore their data was excluded. Further examination revealed two male outliers whose data was also not included in further calculations. Results revealed a main effect of music on endurance time ($p<0.001$) as well as a main effect on trial point for RPE ($p<0.001$). Table 2 demonstrates the effect that music had on endurance time; Table 3 displays the repeated measures ANOVA for RPE.

Table 2. Main Effect of Music on Endurance Time

Endurance	Condition	*M*	*SD*	F ratio	η_p^2
	Motivational Music	17.84	7.20		
	Oudeterous Music	16.84	6.64	15.13	0.38
	No- Music Control	15.56	5.93		

Table 3. Repeated-Measures ANOVA for RPE

RPE	Condition	2 Minutes after start		Trial Mid Point		2 Minutes before end	
		M	*SD*	*M*	*SD*	*M*	*SD*
	Motivational Music	2.46	1.39	5.48	1.62	8.5	1.27
	Oudeterous Music	2.88	1.14	5.75	1.17	8.5	1.14
	No- Music Control	3.04	1.61	5.63	1.62	8.38	1.42

Music Condition x Measurement Point Interaction Effects:
RPE: $p>0.05$

Music Condition Main Effects: RPE: $p>0.05$
Measurement Point Main Effects: RPE: $p<0.001$

In Dyrlund and Wininger (2008) the outcomes that were measured were: enjoyment, RPE, attentional focus, and attend to focus. The outcomes were measured with: the 15-point Borg Scale for RPE, the Intrinsic Motivation Inventory, One-Way ANOVA, 3x3 ANOVA, and a 3x3 repeated ANOVA. Participants were assigned to one intensity condition and one music condition. During the exercise session the treadmill speed was set to coincide with the assigned intensity (low, moderate, or high) and maintained for the full 20 minutes. RPE was evaluated on the Borg scale at the 10-minute and 20-minute mark. After the exercise was finished the participant completed the IMI to assess enjoyment. A 3x3 ANOVA on enjoyment resulted in no clinical significance in enjoyment by music or intensity. A 3x3 ANOVA for music condition and intensity was conducted and revealed clinically significant main effect for intensity ($p<0.001$). However there were no main effects found for music conditions and RPE. Table 4 illustrates the RPE values at 20 minutes by exercise intensity and music condition. Retrospectively the studied looked at the results and calculated a 3x3 ANOVA on enjoyment after including data only from participants that actively paid attention to the music. This new calculation had participants from the most preferred and least preferred music conditions and revealed a significant main effect of music on exercise enjoyment ($p = 0.04$). There were no clinically significant findings for RPE in interaction or main effect for music or intensity.

Table 4. Mean and Standard Deviation for RPE at 20-minutes by Exercise Intensity and Music Preference

Intensity	No Music		Least Preferred Music		Most Preferred Music		Total	
	M	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*

Low	8.27	2.10	7.39	1.92	7.64	1.84	7.76	1.96
Moderate	10.7	2.7	10.82	2.65	10.48	2.42	10.67	2.56
High	13.61	1.61	13.91	2.67	14.40	2.28	13.98	2.25
Total	10.69	3.07	10.66	3.60	10.73	3.52	10.69	3.4

In the Potteiger et al. (2000) randomized control study the outcome studied was: rate of perceived exertion. The outcome was measured with: the 15-point Borg Scale, a Three-Way Repeated Measures Analysis of Variance, and Tukey's HSD *post hoc* test. The Tukey's HSD *post hoc* test was only used to assess any areas of difference between mean values. The Three-Way Repeated Measures Analysis of Variance was used to compare condition by sex by time. However there were no significant differences found between genders so the results were subsequently collapsed. Overall RPE was measured throughout the exercise bout at 5-minute intervals (5, 10, 15, and 20 minutes). Results reveal that there were clinically significant differences among the different music conditions at each measurement interval. The no music intervention was constantly significantly higher than the other three music conditions at 5, 10, 15, and 20 minutes. Table 5 illustrates the measured RPE for each music condition per 5-minute interval.

Table 5. Overall RPE Values Reported at 5 minute intervals during Moderate Intensity Exercise

Condition	5 minutes		10 minutes		15 minutes		20 minutes	
	M	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*
Fast Music	11.1	0.3	12.4	0.3	13.6	0.3	14.2	0.3
Classical Music	11.2	0.3	12.6	0.3	13.7	0.3	14.1	0.3
Self-Selected Music	11.1	0.3	12.4	0.3	13.7	0.3	14.4	0.3
No Music	12.1	0.3	13.3	0.3	14.5	0.3	15.2	0.3

The results from the Potteiger et al. (2000) found that music has the possibility to passively distract participants and influence RPE during moderately intense exercise. The Dyrlund and

Wininger (2008) study results were inconclusive. They found that music has the potential for enhancing enjoyment during exercise if the music is prominent enough to gain the participants' attention. The effects of listening to music on RPE showed no significant difference; but it is unsure if exercise intensity nullified any effect that music had on RPE by overcoming any dissociation or distraction that had been in effect by the music. The Karageorghis et al. (2009) study refuted the hypothesis that RPE would be lower for the participants in the motivational music category compared to the oudeterous music group and no music control group. It is possible that this aspect of the study was underpowered and/or that the participants' attentional capacity was reached while trying to keep in sync with the music rhythm at higher intensities.

DISCUSSION

There are contradicting findings between these studies about the effect that music has on RPE and exercise. This comes from a number of differing variables. In the Karageorghis et al. (2009) study the participants were asked to walk until exhaustion at a moderate intensity and to keep pace with the rhythm of the music. They found that listening to music did not effect RPE, but it is possible that the exercise intensity too high so that it negated the music effects. Training modality should also be kept in mind; if the participants did not walk at a moderate intensity regularly they might perceive that they are working harder as they acclimate to the new activity. Also in this study the participants had to stay synchronized to the music, which could have been rather difficult for participants. The extra stress of keeping with the beat could have enhanced fatigue and increased RPE ratings during exercise. Potteiger et al. (2000) found that music has the possibility to passively distract participants and decrease RPE during moderately intense exercise when compared to the no music condition but there were no clinical significant findings between the different music conditions. A suggestion for further research would be to

investigate what music conditions lower RPE. The Dyrlund and Wininger (2008) study found that when participants listen to most preferred music and attended to it they reported more exercise enjoyment. However, if the participants are not paying attention to the music, it loses the beneficial effects. It was also noted that participants that listened to their most preferred music enjoyed their exercise experience more than the least preferred group, which enjoyed their exercise session more than the no music group. This hierarchy suggests that listening to music of any preference can effect exercise enjoyment. The study found that music did not have any effect on RPE during exercise. Even though some participants listened to their most preferred type of music the song might not have provided enough cognitive demand to provide the dissociation necessary to reduce RPE. This suggests that participants might have decreased RPE if they were able to bring self-selected music to listen to during exercise.

These studies were limited in the population recruited for the activities and in the sample size of the studies. It would be pertinent to continue this research with more studies addressing the previous limitations as well as to increase the amount of data available by increasing the sample size. Two of the three studies only recruited healthy, active collegiate aged participants; these studies could have differing outcomes with a different aged population at the subjects.

CONCLUSIONS

The results of whether or not listening to music during exercise can decrease RPE are inconclusive at this time, due to the lack of definitive results the hypothesis is rejected. For clarification on this more research should be done to account for the uncontrolled variables and new questions that arose from these current studies. One new study design could look at the effect of listening to music during low to moderate intensity exercise in a physically inactive population, or an older population, where the effects of music could be more profound. Another

study design option would be to test out more differing types of music, such as self-selected music. There would be a greater chance for successful dissociation if there were more music options for participants, mainly because personal preference varies greatly from person to person and is hard to control. The type of exercise that is used might be affecting the outcomes as well, especially if it is an activity that the subject participates in regularly or does not participate in regularly. Therefore another study could explore the effects that listening to music has on different exercises, such as biking, walking, or running.

Music has the potential to decrease RPE during a bout of exercise and increase exercise adherence, endurance time, or ability to complete a single exercise session. Follow up studies will shed more information on this the potential benefit. If it can be proven that music helps decrease RPE and can increase exercise adherence then new plans can be put into place to help treat the growing obesity and overweight issues in the United States today.

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